A Laboratory Assessment of Modified Concrete by Partial Replacement of Cement by Silica Fume and with Steel Fibers

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Abstract— This thesis presents results of concrete containing Portland Pozzolona cement (PPC) with silica fume (SF) and steel fibers. The tests are carried out in laboratory on M30 grade of concrete at 7 and 28 days of age. As far as the compressive strength is concerned, the replacement of cement by 10% of SF improved performance of concrete. In this thesis we used Silica Fume of 10% , 15% with addition of steel fibers of diameter 0.6 mm diameter and length 30mm, at various percentages as 0%, 0.2 %, 0.4%,0.6 %,0.8%, and 1.0 % by weight of on m3 concrete on M-30 grade of concrete.

Key words: Concrete Mix, Silica Fume, Steel Fiber, Compressive Strength

I. INTRODUCTION

Silica fume otherwise called miniaturized scale silica is a by-item Ad of the decrease of high-virtue quartz with coal in electric heaters in the generation of silicon and ferrosilicon combinations. Be-reason for its superb fineness and high silica content, silicon oxide Fume is an passing powerful pozzolanic material. silicon oxide Fume is used as a region of cement to boost its properties like compressive quality, bond quality, and scraped space resistance; lessens penetrability; and during this manner aides in shielding strengthening steel from erosion.

II. SILICA FUME

Silica fume, additionally referred to as micro-silica, is associate degree amorphous (non-crystalline) organism of oxide, silica. it is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consists of spherical particles with a median particle diameter of 150 nm. the most field of application is as pozzolanic material for prime performance concrete. The pozzolanic reactions occur once oxide fume is more to the concrete mixture, and therefore the amorphous oxide, that is that the major element of the pozzolana, reacts with metal hydroxide formed from the hydration of the calcium silicates with the resulting product being a calcium silicate hydrate (C-S-H).

III. STEEL FIBERS

Steel fibers can improve the structural strength to reduce in the heavy steel reinforcement requirement. Freeze thaw resistance of the concrete is improved. Durability of the concrete is improved to reduce in the crack width. It has been shown in the research that fibers with low volume fractions (<1%), in fiber reinforced concrete, have an insignificant effect on both the compressive and tensile strength Improve structural strength. When the fiber reinforcement is in the form of short discrete fibers, they act effectively as rigid inclusions in the concrete matrix. Physically, they have thus the same order of magnitude as aggregate inclusions; steel fibre reinforcement cannot therefore be regarded as a direct replacement aggregates. However, because of the inherent material properties of fiber concrete, the presence of fibers in the body of the concrete can be expected to improve the resistance of conventional structural members to cracking, deflection and other serviceability conditions.

IV. LITERATURE REVIEW

Abdullah et al. (2004), studied the effect of silica fume and type of coarse aggregates on the split tensile strength, compressive strength and modulus of elasticity of low quality coarse aggregate concrete of both silica fume and plain cement concretes. It was observed that the addition of silica fume enhanced the compressive strength and split tensile strength of all concretes especially of the low quality limestone aggregates. The compressive strength development of the concrete specimens organized with the other coarse aggregates as shown in Fig. 2.1. In these specimens the compressive strength of silica fume cement concrete was also in surplus of that of plain cement concrete specimens. The highest compressive strength was measured in the concrete specimens prepared with steel-slag aggregates while the lowest compressive strength was noted in the concrete specimens prepared with calcareous limestone aggregates.

Katkhuda et al. (2009), were evaluated the effect of silica fume on tensile, flexure and compressive strengths on high strength lightweight concrete, they replace silica fume by 0%, 5%, 10%, 15%, 20% and 25% for w/c ratios 0.26, 0.3, 0.34, 0.38 and 0.42, the peak silica fume replacement percentages for obtaining maximum 28 day compressive strength and flexure strengths of lightweight high strength concrete ranges from 15% to 25% depending on the w/c ratio of the mix as shown in Fig. 2.3 and Fig. 2.4. The optimum percentage of silica fume replacement increases with the increase of w/c ratio. Amudhavalli and Mathew (2012), were evaluated that the optimum 7 day and 28 day flexural strength and compressive strength have been obtained in the replacement range of 10-15 % of silica fume. Increase in split tensile strength beyond 10 % silica fume replacement is almost insignificant whereas increase in flexural tensile strength have occurred up to 15 % replacements.

Sai et al. (2013), were observed that with addition of silica fume and nano silica the compressive strength and flexural strength of concrete mix at 7 day and 28 day are more than that of controlled specimen Fig. 2.5 and maximum compressive strength and flexural strength was found with 10% of silica fume and 2% of nano silica combination, they also observed that the compressive strength of concrete with 5% silica fume gives same result as 2% nano silica.

Sridhar and Vanakudre (2014), were compared the mechanical properties i.e. compressive strength with M20 and M40 grade of concrete and with different replacement levels of ordinary Portland cement with nano silica (0.25%, 0.5%, 0.75%, 1.0%, 1.25%, 1.5%, 1.75%, 2.0% 2.25%, 2.5%) used. the optimum replacement of Nano Silica is 2% and 1.5% respectively for M20 & M40 concrete. The percentage increase in M20 concrete is 15.31, 16.3 respectively for 7 day and 28 day, where as in M40 concrete is 11.0, 11.20 respectively for 7 day and 28 days.

Gupta et al. (2015), were estimated the impact resistance of concrete containing waste rubber fibers and silica fume. Compressive strength of control concrete without rubber fiber and silica fume increases from 58.97 N/mm2 to 75.20 N/mm2, 50.43 N/ mm2 to 62.70 N/mm2 and 33.70 N/mm2 to 39.70 N/mm2 for w/c ratios of 0.35, 0.45 and 0.55 respectively, other hand on 10% replacement of cement by silica fume, compressive strength of rubber fiber concrete with 25% rubber fiber and 10% replacement of cement by silica fume, increases from 28.43 N/mm2 to 37.90 N/mm2, 23.60 N/mm2 to 29.90 N/mm2 and 15.30 N/mm2 to 19.10 N/ mm2 for w/c ratios of 0.35, 0.45 and 0.55 respectively.

V. RESULT

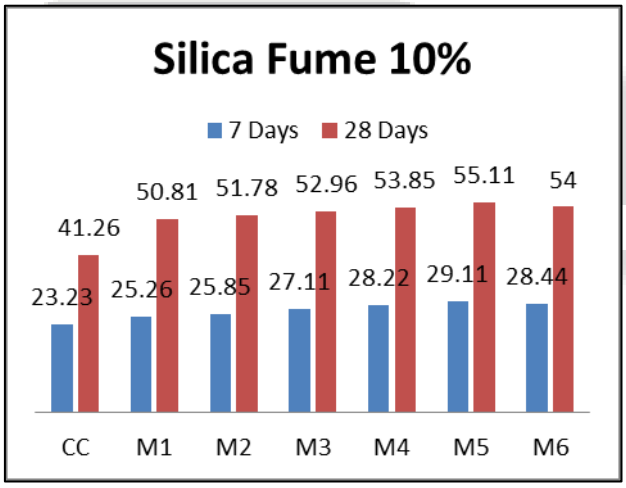

Fig. 1: Bar chart comparison of compressive strength of concrete with Silica fume 10 % using steel fibers

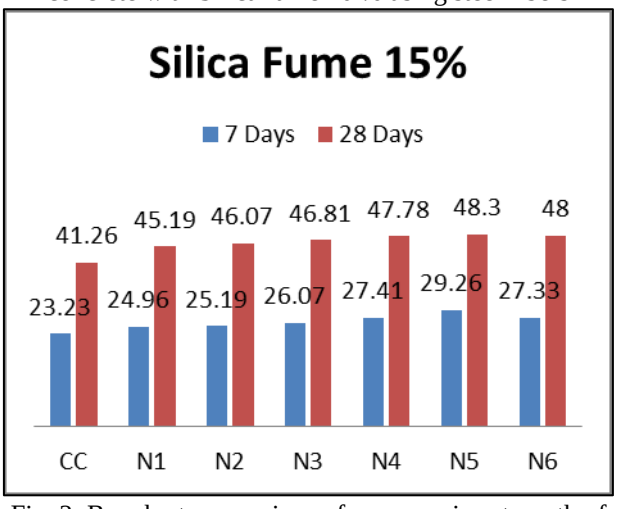

Fig. 2: Bar chart comparison of compressive strength of concrete with Silica fume 15 % using steel fibers

VI. CONCLUSIONS

The compressive strength increases with the increase in silica fume compared with normal concrete. The values that are obtained at 7 days and 28 days of curing for 10% of silica fume replaced by PPC cement. As compare to 15% of silica fume in replacement of cement.

1) When the cement is replaced with 10% silica fume and 0.8% steel fibers and e waste gives the optimum compressive strength.
2) At 10% silica fume and 0.8% steel fiber and e waste replacement to cement increases compressive strength than conventional concrete in 28 days.
3) From the experimental results, the following conclusion can be drawn:
4) At 10% silica fume and 0.8% steel fibers replacement to cement increases compressive strength up to 25.13% than conventional concrete in 28 days.
5) At 10% silica fume and 0.8% steel fibers replacement to cement increases compressive strength up to 20.19% than conventional concrete in 7 days.
6) At 15% silica fume and 0.8% steel fibers replacement to cement increases compressive strength up to 14.58% than conventional concrete in 28 days.
7) At 15% silica fume and 0.8% steel fibers replacement to cement increases compressive strength up to 20.6% than conventional concrete in 7 days.
8) On the basis of regression analysis of large number of experimental results showed in figures has been developed. The proposed model was found to have good accuracy in estimating the 28 days Compressive strength with their inter relationship at 10% , 15% Silica Fume & 0%,0.2%,0.4%,0.6%,0.8%,1.0% of Steel Fibers.

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